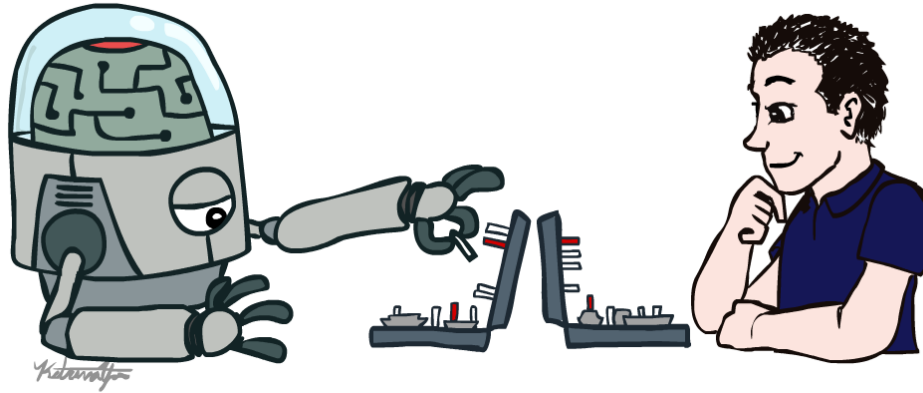


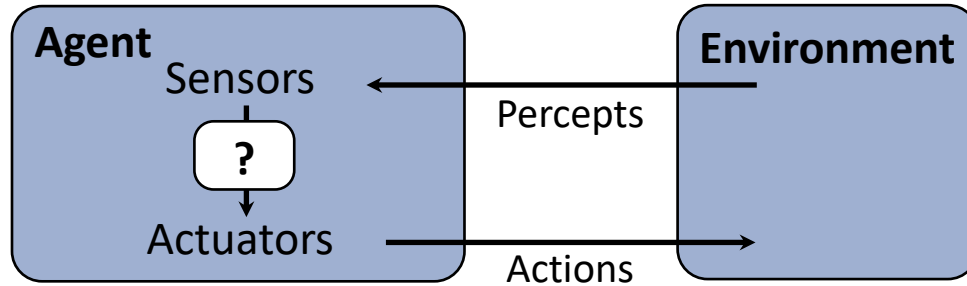
Artificial Intelligence

Lecture 2: Agents



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Agents and environments



- An agent **perceives** its environment through **sensors** and **acts** upon it through **actuators** (or *effectors*, depending on whom you ask)
- The **agent function** maps percept sequences to actions
- It is generated by an **agent program** running on a **machine**

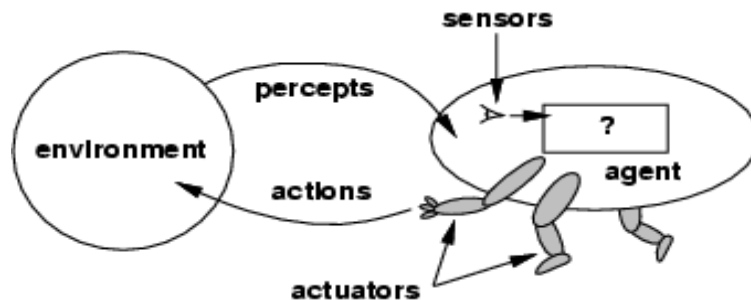
Agents

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators
- Human agent:
 - eyes, ears, and other organs for sensors;
 - legs, mouth, and other body parts for actuators
- Robotic agent:
 - cameras and infrared range finders for sensors;
 - various motors for actuators
- Software agents or softbots that have some functions as sensors and some functions as actuators.

Glossary

- Percept
agents perceptual inputs
- Percept sequence
History of everything the agent has perceived
- Agent function
Describes agent's behaviour – maps any percept to an action
- Agent program
Implements agent function

Agents and environments



- The agent function maps from percept histories to actions:

$$[f: P^* \rightarrow A]$$

- The agent program runs on the physical architecture to produce f

agent = architecture + program

Intelligent Agents

- The fundamental faculties of intelligence are
 - Acting
 - Sensing
 - Understanding, reasoning, learning
- An **Intelligent Agent** must sense, must act, must be autonomous (to some extent).
- It also
 - must be rational
- AI is about building rational agents.

Rational Agent

- An agent should strive to "do the right thing", based on what it can perceive and the actions it can perform.
- What is the right thing?
Causes the agent to be most successful
Caution: Rationality is not the same as Perfection. Rationality maximizes "Expected Performance".
Perfection maximizes "Actual Performance"
- **Performance measure** – is a criteria to measure an agent's behavior
e.g., performance measure of a vacuum-cleaner agent could be amount of dirt cleaned up, amount of time taken, amount of electricity consumed, amount of noise generated, etc.

Performance is measured according to what is wanted in the environment instead of how the agent should behave.

Rationality – Cont'd

- What is rationality? Depends on four things:
 - The **performance measure**
 - The agent's prior knowledge of the **environment**
 - The **actions** the agent can perform
 - The agent's **percept sequence** to date

- A **rational agent** is:

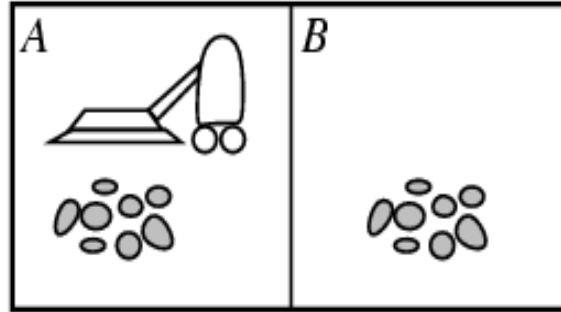
For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and what ever built in knowledge the agent has.

Rational Agents – Cont'd

- Rationality is distinct from omniscience (all-knowing with infinite knowledge)
- Agents can perform actions in order to modify future percepts so as to obtain useful information (information gathering, exploration – an important part of rationality)
- An agent is autonomous if its behavior is determined by its own experience (with ability to learn and adapt) – a rational agent should be autonomous!

Rational \Rightarrow exploration, learning, autonomy

Example: Vacuum-cleaner Agent



- ❑ **Environment:** square A and B
- ❑ **Percepts:** [location and content] e.g. *[A, Dirty]*
- ❑ **Actions:** left, right, suck, and no-op

A simple **agent function** may be “if the current square is dirty, then clean or move to the other square..”

Example: Vacuum-cleaner Agent

Percept sequence	Action
[A,Clean]	Right
[A, Dirty]	Suck
[B, Clean]	Left
[B, Dirty]	Suck
[A, Clean],[A, Clean]	Right
[A, Clean],[A, Dirty]	Suck
...	...

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Agent Program !

function **REFLEX-VACUUM-AGENT**(*[location,status]*) *returns* action

if status = Dirty then return Clean

else if location = A then return Right

else if location = B then return Left

Is our vacuum-cleaner agent rational?

Keeping in view four aspects to measure rationality:

- The **performance measure** awards one point for each clean square at each time step over 10000 time steps.
- The geography of the **environment** is known.
 - Clean squares stay clean and sucking cleans the current square.
- Only **actions** are left, right, suck, and NoOp
- The agent correctly **perceives** its location and whether that location contains dirt.

What's your Answer -- Yes/No

Building Rational Agents

PEAS Description to Specify Task Environments

To design a rational agent we need to specify a *task environment*, and a problem specification for which the agent is a solution

PEAS:

- **P:** Performance Measure
- **E:** Environment
- **A:** Actuators
- **S:** Sensors

Agent

Types of Agent

- Simple reflex Agents
- Model-based reflex Agents
- Goal based Agents
- Utility-based Agents

Examples of Agent

It can be

- Program
- Chatbot
- Robot
- Machine
- Car
- Player
- Others

Artificial Intelligence

Environment

Types of Environments

- Observable, Unobservable
- Competitive, Cooperative Multi-agent
- Deterministic, Stochastic
- Nondeterministic
- Static, Dynamic
- Episodic, Sequential
- Known, Unknown
- Discrete, Continuous

Examples of Environment

It depends on the application for
example chess, Maze, outer space, etc.,

A human agent in Pacman



The task environment - PEAS

- Performance measure
 - -1 per step; + 10 food; +500 win; -500 die; +200 hit scared ghost
- Environment
 - Pacman dynamics (incl ghost behavior)
- Actuators
 - Left Right Up Down or NSEW
- Sensors
 - Entire state is visible (except power pellet duration)



PEAS: Automated taxi

- Performance measure
 - Income, happy customer, vehicle costs, fines, insurance premiums
- Environment
 - US streets, other drivers, customers, weather, police...
- Actuators
 - Steering, brake, gas, display/speaker
- Sensors
 - Camera, radar, accelerometer, engine sensors, microphone, GPS



Image: <http://nypost.com/2014/06/21/how-google-might-put-taxi-drivers-out-of-business/>

PEAS: Medical diagnosis system

- Performance measure
 - Patient health, cost, reputation
- Environment
 - Patients, medical staff, insurers, courts
- Actuators
 - Screen display, email
- Sensors
 - Keyboard/mouse

